# Littoral Zone Oceanography for ASW/MIW

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## OBJECTIVES

The objectives of the project are to improve current Navy's Impact Burial Prediction Model (IBPM) and Mine acoustic detection model (CASS-GRAB) using the advanced hydrodynamic theory and littoral zone oceanography. The efforts are closely connected to the field experiment at Corpus Christi, Texas-Louisiana shelf sponsored by ONR IBPM program. This effort provides guidance for field experiments such as site selection, determination of variables to be measured (e.g., ocean and sediment conditions as well as mine burial depth). On the other hand, data collected from the field experiments will be used to verify the reconstructed IBPM in a more realistic environmental scenario.

## SUMMARY

During the performance period, Peter Chu improved the U.S. Navy's mine acoustic detection model and mine burial prediction models using realistic marginal sea ocean models and data. He published (or in press) 19 papers in peer-reviewed journals, 3 chapters in book volumes, and 5 papers in conference proceedings. He also presented one invited paper and 16 contributed papers in various workshops and professional societies.

## PUBLICATIONS

### (a) Refereed Journal Publications

(1) Chu, P.C., and L.M. Ivanov, 2005: Statistical characteristics of irreversible predictability time in regional ocean models. Nonlinear Processes in Geophysics, 12, 1-10.
(2) Chu, P.C., L.M. Ivanov, and O.M. Melnichenko, 2005: Fall-winter current reversals on the Texas-Lousiana continental shelf. Journal of Physical Oceanography, 35, 902-910.
(3) Chu, P.C., C.-L. Fang,and C.S. Kim, 2005: Japan/East Sea model predictability. Continental Shelf Research, 25, 2107-2121.
(4) Chu, P.C., A. Gilles, and C.W. Fan, 2005: Experiment of falling cylinder through the water column. Experimental and Thermal Fluid Sciences, 29, 555-568.

(5) Chu, P.C., and C.W. Fan, 2005: Pseudo-cylinder parameterization for mine impact burial prediction. Journal of Fluids Engineering, 127, 1515-1520.

(6) Chu, P.C., L.M. Ivanov, and T.M. Margolina, 2005: Seasonal variability of the Black Sea Chlorophyll-a concentration. Journal of Marine Systems, 56, 243-261.

(7) Chu, P.C., S.H. Lu,and Y.C. Chen, 2005: A Numerical Modeling Study on Desert Oasis Self-Supporting Mechanisms. Journal of Hydrology, 312, 256-276.

(8) Chu, P.C., M. Cornelious, and M. Wagstaff, 2005: Effects of suspended sediment on acoustic detection using reverberation. Marine Technology Society Journal, 39 (2), 105-109.

(9) Li, R.-F., X.-B. You, and P.C. Chu, 2005: The eastward subtropical countercurrent on isopycnal surface in the western North Pacific. Science in China Ser D. Earth Sciences, 48 (7), 1065-1073.

(10) Chu, P.C., Y.C. Chen, and A. Kuninaka, 2005: Seasonal variability of the East China/Yellow Sea surface buoyancy flux and thermohaline structure. Advances in Atmospheric Sciences, 22, 1-20.

(11) Chu, P.C., 2005: First-passage time for stability analysis of the Kaldor model. Chaos, olitons and Fractals, 27, 1355-1368, in press.

(12) Chu, P.C., and C.W. Fan, 2005: Prediction of falling cylinder through air-water-sediment columns. Journal of Applied Fluid Mechanics, in press.

(13) Chu, P.C.,and C.W. Fan, 2005: An inverse model for calculation of global volume transport from wind and hydrographic data. Journal of Marine Systems, in press.

(14) Chu, P.C., and K.F. Cheng, 2005: Effect of Wave Boundary Layer on the Sea-to-Air Dimethylsulfide Transfer Velocity during Typhoon Passage. Journal of Marine Systems, in press.

(15) Chu, P.C., S. Mancini, E. L. Gottshall, D. S. Cwalina , C. N. Barron, 2006: Sensitivity of satellite altimetry data assimilation on weapon acoustic preset using MODAS. IEEE Journal of Oceanic Engineering, in press.

(16)  Chu P.C., M. Cornelius, and M. Wagstaff, 2005:  Suspended sediment effect on buried mine detection using CASS/GRAB model, U.S. Navy's Journal of Undersea Acoustics, in press.

(17) Hou, S., J. Chappellaz, J. Jouzel, P. Chu, V. Masson-Delmotte, D. Qin, D. Raynaud, P. Mayewski, V. Lipenkov, and S. Kang, 2005: Summer temperature trend over the past two millennia using air content in himalayan ice. Climate of the Past, European Geophysical Society, in press.

(18) Park S, and P.C. Chu, 2005: Interannual SST variability in the Japan/East Sea and relationship with environmental variables. Journal of Oceanography, in press.

(19) Park S, and P.C. Chu, 2005: Thermal and haline fronts in the Yellow/East China Seas: surface and subsurface seasonality comparison. Journal of Oceanography, conditionally accepted.

(20) Chu, P.C., and C.W. Fan, 2005: Sediment resistant parameterization for improvement of  3D mine impact burial prediction model. IEEE Journal of Oceanic Engineering, in revision.

(21) Chu, P.C., 2005: Mine impact burial prediction from one to three dimensions. IEEE Journal of Oceanic Engineering, in revision.

**(b) Book Chapters:**

(1) Chu, P.C., G. Ray, and C.W. Fan, 2005: Prediction of High Speed Rigid Body Maneuvering in Air-Water-Sediment Columns, Advances in Fluid Mechanics, 7, in press

(2) Chu, P.C., K. Kyriakidis, and M. Ward, 2005: Two chemical dispersion regimes in tide-dominated San Diego Bay, Chapter 10, in: Challenges in Coastal Hydrology and Water Quality, edited by Vijay P. Singh and Y. Jun Xu, Water Resources Publications (36 pages), in press.

(3) Chu, P.C., P. Pauly, and M. Ward, 2005: Wind effect on chemical dispersion in San Andrew Bay, Chapter 11, in: Challenges in Coastal Hydrology and Water Quality, edited by Vijay P. Singh and Y. Jun Xu, Water Resources Publications, (48 pages), in press.

**(b) Conference Proceedings**

(1) Chu, P.C., Y.C. Chen, S.H. Lu, Z. Li, and Y. Lu, Severe particulate pollution in Lanzhou China. Air Quality Management at Urban, Regional, and Global Scales, 364-373, Third International Symposium on Air Quality Management, Istanbul, Turkey, 26-30 September 2005.

(2) Chu, P.C., Y.C. Chen, and S.H. Lu, Afforestation for improving valley urban air quality. Air Quality Management at Urban, Regional, and Global Scales, 1379-1388, Third International Symposium on Air Quality Management, Istanbul, Turkey, 26-30 September 2005.

(3) Chu, P.C., G. Amezaga, E.L. Gottshall, and David S.. Cwalina, Assessment of ocean prediction model for Naval operations using acoustic preset. 10 pages, DVD-ROM, The OCEANS 2005 MTS/IEEE Conference Proceedings, Washington D.C., Sept. 19-23, 2005.

(4) Chu, P.C., M. Cornelius, and M. Wegstaff, Detection of suspended sediment effect on sidescan sonar imagery using the Navy's CASS-GRAB model. 10 pages, DVD-ROM, The OCEANS 2005 MTS/IEEE Conference Proceedings, Washington D.C., Sept. 19-23, 2005.

(5) Chu, P.C., and A. E. Armstrong, Instantaneous current prediction for Naval operations. 10 pages, DVD-ROM, The OCEANS 2005 MTS/IEEE Conference Proceedings, Washington D.C., Sept. 19-23, 2005.

**(c) Conference Presentations (Invited)**

Chu, P.C., Verification of the three dimensional mine impact prediciton model (IMPACT35). The ONR Mine Impact Burial Prediction Workshop, Kailua-Kona, Hawaii, Jan 31 - Feb 2, 2005.

**(d) Conference Presentations (Contributed)**

(1) Chu, P.C., L.M. Ivanov, and O. V. Melnichenko, Prediction of Synoptic Current Reversals on the Louisiana-Texas Continental Shelf, Sixth Conference on Coastal

Atmospheric and Oceanic Prediction and Processes, American Meteorological Society, San Diego, January 9-13, 2005.

(2) Chu, P.C., and L.M. Ivanov, Model Predictability- From Lorenz System to Operational Ocean/Atmospheric Models, Lorenz Symposium, American Meteorological Society, San Diego, January 9-13, 2005.

(3) Chu, P.C., S.H. Lu, and Y.C. Chen, Desert Oasis Self Preservation Mechanisms, 19th Hydrology Conference, American Meteorological Society, San Diego, January 9-13, 2005.

(4) Chu, P.C., and L.M. Ivanov, Optimal Spectral Decomposition (OSD) Method for Ocean Observing System. Ninth Symposium on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface (IOAS-AOLS), American Meteorological Society, San Diego, January 9-13, 2005.

(5) Chu, P.C., P-Vector Method for Determining Arctic Ocean Circulation from the Joint US-Russian Hydrographic Data. 8th Conference on Polar Meteorology and Oceanography, American Meteorological Society, San Diego, January 9-13, 2005.

(6) Chu, P.C., Mine impact burial prediction. Joint Undersea Warfare Technology Spring Conference, "Altering the Calculus: Integrated Undersea Warfare", the National Defense Industrial Association, San Diego, California, March 29-31, 2005.

(7) Chu, P.C., S.H. Lu, and Y.C. Chen, Oasis breeze circulation for the desert oasis self preservation. European Geophysical Union, General Assembly, Vienna, Austr1a, April 25-29, 2005.

(8) Chu, P.C., O. Melnichenko, and L.M. Ivanov, Determination of mid-depth circulation of the North Atlantic Ocean from ARGO data using the optimal spectral decomposition method. European Geophysical Union, General Assembly, Vienna, Austr1a, April 25-29, 2005.

(9) Chu, P.C., and L.M. Ivanov, Irreversible predictability time - a quantitative measure of model predictability. European Geophysical Union, General Assembly, Vienna, Austr1a, April 25-29, 2005.

(10) Chu, P.C., K.F. Cheng, and Y.C. Chen, Wave effect on the gas transfer at water surfaces. 37th International Liege Colloquium on Ocean Dynamics, Liege, Belgium, May 2-6, 2005.

(11) Chu, P.C., Y.C. Chen, S.H. Lu, Z. Li, and Y. Lu, Severe particulate pollution in Lanzhou China. Third International Symposium on Air Quality Management, Istanbul, Turkey, 26-30 September 2005.

(12) Chu, P.C., Y.C. Chen, and S.H. Lu, Afforestation for improving valley urban air quality. Third International Symposium on Air Quality Management, Istanbul, Turkey, 26-30 September 2005.

(13) Chu, P.C., G. Amezaga, E.L. Gottshall, and D. Cwalina, Assessment of ocean prediction model for naval operations using acoustic preset. The OCEANS 2005 MTS/IEEE Conference, Washington D.C., September 16-20, 2005.

(14) Chu, P.C., M. Cornelius, M. Wagstaff, Effect of suspended sediment on acoustic detection using the Navy's CASS/GRAB model. The OCEANS 2005 MTS/IEEE Conference, Washington D.C., September 16-20, 2005.

(15) Chu, P.C., and A.E. Armstrong, Instantaneous current prediction for naval operations. The OCEANS 2005 MTS/IEEE Conference, Washington D.C., September 16-20, 2005.

(16) Chu, P.C., L.M. Ivanov, and T.M. Margolina, Rotation Matrix Method for Analyzing Noisy Nonlinear Data. American Geophysical Union Fall Meeting, San Francisco, December 4-10, 2005.


**THESES DIRECTED:**

Kleanthis Kyriakidis, Baroclinicity, forcing mechanism, and prediction of chemical propagation of San Diego Bay and their effects on Naval applications, MS in Physical Oceanography (with distinction) June 2005 [Co-advised by Steven D. Haeger (NAVO)].

Patrice Pauly, Sensitivity study of St.Andrew Bay rapid response system for Naval Applications", MS in Physical Oceanography (with distinction), June 2005 [Co-advised by Steven D. Haeger (NAVO)].